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Surgical Treatment of Double Valve Endocarditis

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ABSTRACT

Background: We have retrospectively analyzed the results of the operations made for aortic infective endocarditis with mitral involvement in a single center in 19 years.

Methods: From May 1992 to January 2011, we have operated on 72 patients with infective endocarditis of the aortic valve with mitral valve involvement. Fifty-two patients (72.2%) were male and the mean age was 40.5 ± 15.5 (9-73) years. The blood cultures were positive in 33 patients (45.8%) and the most commonly identified microorganism was Streptococcus. Nine patients (12.5%) had prosthetic valve endocarditis. The mean duration of follow-up was 6.8 ± 4.7 (0.1-16.9) years, adding up to a total of 156.1 patient/years.

Results: A total of 155 procedures were performed on these 72 patients. The most commonly performed procedure was aortic valve replacement, in 63 patients (87.5%). Aortic annular involvement was present in 9 cases (12.5%). In-hospital mortality was seen in 13 patients (18.1%). Postoperatively, 13 (18.1%) patients had low cardiac output, 9 (12.5%) had heart block, and only 1 of them required permanent pacemaker implantation. The actuarial survival rates for 1, 5, and 10 years were 96.4% ± 2.5%, 84.4% ± 5.1%, and 77.4 ± 6.7%, respectively.

Conclusions: Double-valve endocarditis is a serious condition and the surgeon must be aware of the high rates of mortality and morbidity in these patients. Although no association was found, heart blocks and septic embolization must be handled with caution. The patients generally do well after surgery, and recurrences and reoperations decrease by the second year after operation.

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INTRODUCTION

Infective endocarditis and its surgical treatment are well-known clinical entities. Results of the surgical treatment strategies have been published and discussed before [Delahaye 2004; David 2007; Prendergast 2010]. However, there has been scant literature on the surgical treatment and outcome of double-valve endocarditis in recent years. We have analyzed the results of the surgical treatment of double-valve endocarditis over a period of 19 years.

MATERIALS AND METHODS

The patient data were collected from the hospital records retrospectively. From May 1992 to January 2011, 72 consecutive patients with aortic and mitral valve endocarditis underwent surgery at our institution. For the definitions of active, healed, native, and prosthetic and culture-negative endocarditis, modified Aranki criteria have been used [Aranki 1994]. Endocarditis was labeled "active" if the patient had fever and/or leukocytosis at the time of surgery or required surgical treatment before completion of a standard course of antibiotic treatment. Endocarditis was labeled "healed" if surgery was performed after completion of antibiotic treatment and no signs of active infection (fever, leukocytosis) were present. Prosthetic valve endocarditis (PVE) was defined as infection occurring on any type of tissue or mechanical valve device. Culture-negative endocarditis was present when no microorganism could be identified either on serial blood cultures or on cultures from the explanted valvular tissue in patients presenting with the clinical picture of endocarditis, particularly in the presence of a new regurgitant murmur, congestive heart failure, and/or vegetations on echocardiogram. These were confirmed at operation by the presence of leaflet perforation, vegetations, or valvular and perivalvular tissue destruction. The presence of acute or chronic inflammatory changes at microscopy confirmed the diagnosis of endocarditis.

There were 52 male (72.2%) and 20 female (27.8%) patients with a mean age of 40.5 ± 15.5 (9-73) years. Sixty-three patients (87.5%) presented with native valve endocarditis (NVE) and 9 (12.5%) with PVE. Of these 9 PVE cases, 8 of them had double prosthetic valves and 1 had only the aortic valve replaced. None of the PVE cases were early PVE.

Table 1. Preoperative Characteristics

Preoperative Characteristic	n (%)
Fever	42 (58.3%)
Septic emboli	13 (18.1%)
Central	9 (12.5%)
Peripheral	5 (6.9%)
NYHA Class	
Class I	6 (8.3%)
Class II	19 (26.4%)
Class III	32 (44.5%)
Class IV	15 (20.8%)
Congestive heart failure	49 (68.1%)
Left ventricular dysfunction (ejection fraction <40%)	3 (4.2%)
PVE	9 (12.5%)
Periprosthetic leakage	3 (33.3%)*
Emergency operation	15 (20.8%)
Electrocardiography	
Sinus rhythm	62 (86.1%)
Atrial fibrillation	8 (11.1%)
Left bundle branch block	1 (1.4%)
Complete heart block	1 (1.4%)

*Ratio of patients with periprosthetic leakage to the PVE cases.

Vegetations on the mitral valve were detected in 38 cases (52.8%) and gross vegetations on aortic valves were detected in 4 patients (5.6%) preoperatively. Eleven patients (15.3%) had a history of previous cardiac surgery and one of them had 2 cardiac operations previously. The preoperative characteristics are summarized in Table 1.

The diagnosis of infective endocarditis was made according to the Duke criteria [Durack 1994]. All patients were examined by transthoracic (TTE) or transesophageal echocardiography (TEE). Echocardiography revealed valvular vegetation, regurgitation, annular abscess, or aorticoatrial communication or periprosthetic leakage. Aortic annular involvement was considered when an abscess was a region of necrosis that contained purulent material which penetrated into the valvular annulus or the adjacent myocardial structures or when vegetations attacked the aortic annulus or adjacent structures. Coronary angiography was rarely performed, in order to avoid any embolic complications. The blood cultures were positive in 33 patients (45.8%), and the most commonly identified microorganism was Streptococcus (29.2%). The results of the microbiologic studies can be seen in Table 2.

Table 2. Microbiologic Studies

Isolated organism	n (%)
Negative culture	39 (54.1%)
Streptococcus	21 (29.2%)
Staphylococcus	7 (9.7%)
Brucella	2 (2.8%)
Methicillin-resistant *Staphylococcus aureus*	1 (1.4%)
Acinetobacter	1 (1.4%)
Enterobacter	1 (1.4%)

Surgery

A total of 155 procedures were performed on 72 patients. Thirty-two patients (44.4%) underwent surgery in the active phase of the infection. In 40 cases (55.6%), the operation was performed after the antibiotic treatments were completed and the patient was stabilized. Mechanical prosthetic valves were preferred in most of the patients.

All patients underwent moderate (28°C) hypothermic cardiopulmonary bypass by means of bicaval cannulation with cannulation of either the ascending aorta (70 patients) or the femoral artery (2 patients). The left ventricle was vented through the right superior pulmonary vein. Isothermic blood cardioplegic solution was administered via antegrade and retrograde routes during aortic cross-clamping.

For eradication of the aortic valve endocarditis, radical debridement of all necrotic and infected tissues was performed. In cases with annular involvement, the aortic annulus was skeletonized. All infected and necrotic tissues around the annulus and, when present, within the abscess and fistula between the ventriculoarterial junction and the sinotubular junction, were resected. All vegetations were removed. When the aortic valve was not extensively damaged, vegetectomy and reconstruction were preferred. Before cardiopulmonary bypass, a patch was harvested from the pericardium, stabilized with 0.62% glutaraldehyde solution for 5 minutes, and rinsed thoroughly with 0.9% saline solution. When necessary, the pericardial strip was trimmed to an appropriate length and was sutured continuously with 5-0 polypropylene according to the area to be patched. The completely resected annular area was covered with the glutaraldehyde-treated autologous pericardial patch sutured to firm, fibrous tissue for a secure anastomosis or valve implantation. The approaches to the patients with fistulas were reported previously [Kirali 2000; Bozbuga 2004]. The list of procedures can be seen in Table 2. Primary repair of the periprosthetic leak of the mitral valve was preferred in 2 cases. Of the 55 cases with mitral valve replacements, 4 (5.6%) were redo cases.

Follow-up

All patients received at least 4 weeks of antibiotic therapy postoperatively. Broad-range antibiotics (vancomycine and aminoglycosides) were preferred for culture-negative cases. The other patients were treated according to the antibiograms. The patients were involved in a follow-up program in the outpatient clinic of our hospital. The average duration of follow-up was 6.8 ± 4.7 (0.1-16.9) years, adding up to a total of 156.1 patient/years.

Statistical Analysis

The statistical analyses were made with the SPSS 16.0 statistical software package. All continuous variables were expressed as mean ± standard deviation and the ranges were expressed. All discrete variables were expressed as frequencies and percentages. Comparisons of the discrete variables were made by chi-square test. Logistic regression analyses were made for the factors affecting early and late mortality, morbidity, recurrence, and reoperation. The preoperative parameters (septic emboli, congestive heart failure, operation at the active phase of infection, culture-positive cases and bacterial growth, preoperative cardiac rhythm, and New York Heart Association [NYHA] functional classification) were analyzed as independent variables. The survival, freedom from recurrence, and freedom from reoperation analyses were made with Kaplan Meier analysis. The survival comparisons were made with the log-rank test. P values <0.05 were accepted as a statistically significant differences.

RESULTS

Mortality

Thirteen patients (18.1%) had in-hospital mortality. Two of them died intraoperatively. Of these cases, 5 patients had PVE. When compared with the chi-square test, the mortality rates in PVE and NVE were statistically significant (55.6% versus 12.7%; $P = 0.008$). The time and etiology of in-hospital mortality are summarized in Table 4. The logistic regression analysis revealed that the presence of congestive heart failure is associated with in-hospital mortality (odds ratio, 13.75; 95% confidence interval, 1.06-178.40; $P = 0.045$), and the relation persisted after the analysis was adjusted for age and sex.

MORBIDITY

Postoperative fever was seen in 20 patients (27.8%), 6 of whom did not have fever preoperatively. Thirteen patients (18.1%) had low cardiac output and 11 of them died during the postoperative follow-up. Complete heart block was present in 9 patients (12.5%) postoperatively, and 1 of them required permanent pacemaker implantation. One of these patients had PVE. Six of the patients with postoperative heart block had in-hospital mortality due to low cardiac output (5 cases), for pulmonary reasons in 1 case. Two cases with low cardiac output also had sepsis (Table 4). Renal dysfunction was present in 17 patients (23.6%) and 8 (11.1%) required dialysis. Pulmonary morbidity was present in 16 patients (22.2%). Cerebrovascular events occurred in 6 patients (8.3%). Two of them had septic central emboli preoperatively. Of these 6 patients, 4 died in the early follow-up. The patients with PVE and NVE were compared for having any postoperative morbidity, and the difference was not statistically significant (55.6% versus 44.4%; $P = 1.000$). The logistic regression analysis gave no significant association for postoperative morbidity.

Follow-up

Of the surviving 59 patients, follow-up was complete in 56 cases (94.9%). Three patients were lost to follow-up. Twelve patients (21.4%) had mortality after discharge. The time and etiology of long-term mortality is summarized in Table 4. One of these cases had PVE. Four patients were operated on during the active stage of the infection. Two of these patients had recurrences during the follow-up period. One of them had a recurrent infection and periprosthetic leakage at the mitral prosthesis 1 year after the first operation and he underwent reoperation. He died in his 106th month after the first operation, due to heart failure. The other patient with recurrence was managed nonsurgically. He was admitted to hospital in a low cardiac

Table 4. Time and Etiology of Mortality*

Patient no.	Aortic Procedure	Mitral Procedure	Concomitant Procedure	Mortality	Time of Postoperative Mortality	Etiology
1	AVR + repair of Valsalva aneurysm rupture	Mitral reconstruction		In-hospital mortality	31 Days	LCO
2	AVR	Mitral reconstruction	VSD Patch Repair	In-hospital mortality	13 Days	LCO, sepsis
3	Redo AVR	Redo MVR		Intraoperative	0 Days	LCO
4	Aortic reconstruction	Mitral reconstruction		In-hospital mortality	11 Days	LCO
5	Homograft replacement of aortic root	MVR		In-hospital mortality	48 Days	LCO, sepsis
6	AVR	Mitral reconstruction		In-hospital mortality	23 Days	LCO
7	AVR	MVR	TDVA	In-hospital mortality	18 Days	LCO, sepsis
8	AVR	MVR		In-hospital mortality	5 Days	Sepsis
9	Redo AVR	Redo MVR		In-hospital mortality	27 Days	LCO, sepsis
10	Redo AVR	Mitral vegetectomy		In-hospital mortality	4 Days	LCO
11	AVR	MVR		In-hospital mortality	20 Days	Sepsis, MOF
12	AVR	MVR		Intraoperative	0 Days	LCO
13	AVR	MVR		In-hospital mortality	8 Days	LCO
14	AVR	MVR		Mortality after discharge	140 Months	Extracardiac
15	AVR	MVR		Mortality after discharge	23 Months	Heart failure
16	Aortic reconstruction	Mitral reconstruction		Mortality after discharge	48 Months	Extracardiac
17	AVR	MVR		Mortality after discharge	106 Months	Heart failure
18	AVR	MVR		Mortality after discharge	101 Months	Extracardiac
19	AVR	MVR		Mortality after discharge	1 Month	Heart failure
20	AVR	MVR		Mortality after discharge	4 Months	Recurrence of IE
21	AVR	MVR		Mortality after discharge	176 Months	Heart failure
22	AVR	MVR	VSD Patch Repair	Mortality after discharge	34 Months	Extracardiac
23	AVR	MVR		Mortality after discharge	2 Months	Sudden death
24	Xenograft replacement of aortic root + pericardial patch repair of fistula	Mitral reconstruction		Mortality after discharge	1 Month	Heart failure
25	Primary repair of periprosthetic leakage	Primary repair of periprosthetic leakage		Mortality after discharge	38 Months	Extracardiac

*AVR indicates aortic valve replacement; CVE, cerebrovascular event; IE: infective endocarditis; LCO, low cardiac output; MOF, multiorgan failure; MVR, mitral valve replacement; TDVA, tricuspid De Vega annuloplasty; VSD, ventricular septal defect.

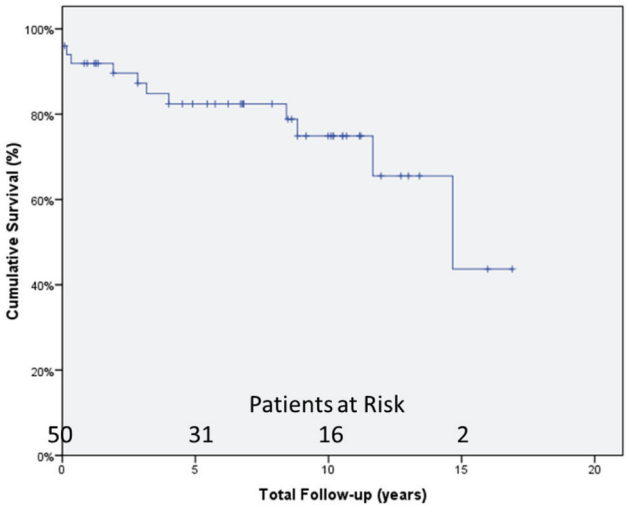

Figure 1. Actuarial survival curve

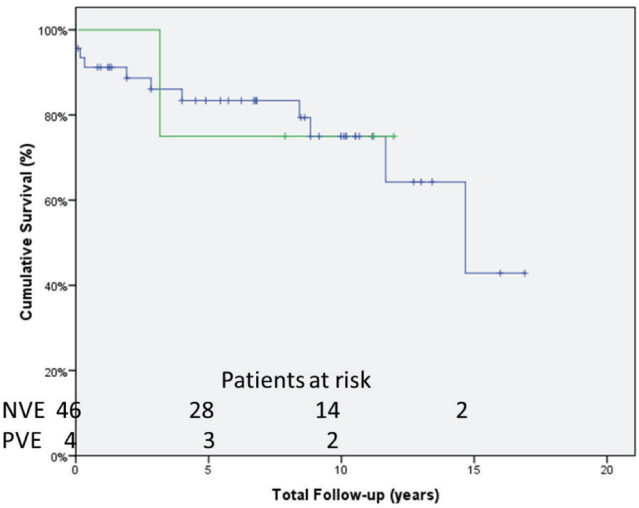

Figure 2. Actuarial survival curve for prosthetic and native valve disease.

output state in the fourth postoperative month. He required inotropic and intraaortic balloon counter pulsation support. The reason for mortality was intractable ventricular fibrillation The actuarial survival rates for 1, 5, and 10 years were 96.4% ± 2.5%, 84.4% ± 5.1%, and 77.4 ± 6.7% respectively (Figure 1). When the patients with prosthetic and native valve disease are compared, the difference between the two groups was not statistically significant (P = 0.935). The actuarial survival rates in patients with NVE for 1, 5, and 10 years were 96.2% ± 2.7%, 85.4% ± 5.1%, and 77.6% ± 7.0%, respectively (Figure 2). The 5-year survival rate for PVE was 75.0% ± 21.7%. None of the factors were found to be associated with long-term mortality in the logistic regression analysis.

Recurrence of infection occurred in 5 cases (6.9%), and 4 patients (5.6%) had reoperations. The blood cultures were negative in 3 of the patients who had recurrences. The other 2 patients had positive cultures for Streptococcus and Staphylococcus, respectively. They were both underwent reoperation and died during these surgeries. Four of the patients with recurrences underwent reoperation. One of them had late mortality as was summarized above. The other patient had periprosthetic leakage of the aortic valve and underwent reoperation 13 months after the original operation. After the operation, this patient is alive and doing well. The other 2 reoperated cases died in the hospital during follow-up. One of them had homograft replacement of the aortic valve and MVR. He was reoperated for periprosthetic leak of the mitral valve on the 26th postoperative day and died during the reoperation. The other patient had aortic valve plus mitral valve replacement. She underwent reoperation for an aortoatrial fistula detected by echocardiography on the eighth postoperative day and she died during the reoperation. The survival rates free from recurrence from infection at 1 and 5 years were 96.2% ± 2.7% and 94.1% ± 3.3%, respectively, and the surviving patients remained stable throughout the follow-up period (Figure 3). The survival rates free from reoperation at 1 and 5 years were 98.0% ± 2.0% and 96.0% ± 2.8%, respectively, and the patients remained stable throughout the follow-up period. None of the factors were found to be associated with recurrence or need for reoperation in the logistic regression analysis.

DISCUSSION

The main finding of this study is the satisfactory long-term survival in the presence of high in-hospital mortality in a group of patients that received mechanical prostheses predominantly.

Double valve endocarditis has been analyzed in previous reports [Gillinov 2001; Oakley 2002; Piper 2002] and has been regarded mostly as a result of jet lesions on the anterior mitral leaflet, especially in NVE [Gillinov 2001]. Secondary involvement of the mitral valve in aortic valve endocarditis is postulated to be due to various causes [Piper 2002]: (i) Formation of abscesses during the spread of infection anteriorly between the right ventricular outflow tract and the mitral-aortic aponeurosis, (ii) contiguous spread of the infection from the noncoronary aortic cusp to the ventricular aspect of the neighboring anterior mitral leaflet, (iii) simultaneous infections of both left heart valves, and (iv) isolated perforation or infection of the anterior mitral valve cusp as a consequence of a diastolic aortic regurgitant flow impinging on the open anterior mitral leaflet. Secondary involvement of the mitral valve is important in aortic root abscess. Siniawski et.al reported that about 25% of their cases had secondary mitral valve disease [Siniawski 2005]. In the group who had double valve surgery, they report 26.4% in-hospital mortality. In our report, it can be seen that 23.8% of the patients who underwent surgery for aortic valve endocarditis had a mitral valve procedure due to involvement by the infectious process. In the 9 patients who had concomitant mitral valve surgery (Table 3), 3 patients (33.3%) had in-hospital mortality in our series.

Table 3. Procedures

Procedures	n (%)*
Mechanical aortic valve replacement	63 (87.5%)
Redo AVR	6 (8.3%)
Aortic root replacement	3 (4.2%)
Bentall de Bono	1 (1.4%)
Xenograft implantation	1 (1.4%)
Homograft implantation	1 (1.4%)
Aortic reconstruction	3 (4.2%)
Vegetectomy of the aortic valve	2 (2.8%)
Fistula repair	1 (1.4%)
Drainage of subaortic abscess and patch repair	1 (1.4%)
Resection of subaortic discrete membrane	1 (1.4%)
Primary repair of periprosthetic leakage	1 (1.4%)
Patch repair of a sinus Valsalva aneurysm repair	1 (1.4%)
Patch repair of an ascending aortic pseudoaneurysm	1 (1.4%)
Patch repair of a ventricular septal defect	2 (2.8%)
De Vega annuloplasty of the tricuspid valve	3 (4.2%)
Coronary artery bypass grafting	1 (1.4%)
Mitral valve procedures	72 (100%)
Mitral valve replacement	55 (76.4%)
Mitral reconstruction	14 (19.4%)
Primary repair of periprosthetic leakage	2 (2.8%)
Vegetectomy of the mitral valve	1 (1.4%)

*Percentages are the ratios of the procedures to the number of patients.

The mortality rate in this report may be a matter of debate. Gillinov and colleagues [Gillinov 2001] have reported no mortality in their experiences with double valve endocarditis. In a recent comprehensive study of the results of the surgical procedures for endocarditis in North America, the reported mortality rate for multiple valve procedures was 13.2% [Gaca 2011]. One of the reasons for the high mortality rate is the high rate of NYHA class III and IV patient s. Note that 2 of the intraoperative deaths in our patients occurred because of low cardiac output, and the main cause of in-hospital mortality was also low cardiac output. Another important feature was the high rate of deaths in patients who had PVE. The mortality rates were significantly different between the NVE and PVE patients. Although a declining trend was evident, many series reported mortality rates around 20% with PVE [Renzulli 2001; Carrel 2003; Leyh 2004].

One important feature of these patients with double valve endocarditis was the need for permanent pacemakers. Preoperatively, only 1 patient (1.4%) had complete heart block. Postoperatively, 9 patients had complete heart block and 6 of them had mortality due to low cardiac output. This fact can be explained by the extent of destruction in these cases. Of the remaining 3 cases, only 1 patient required permanent pacemaker implantation. Although the regression analysis did not reveal any association with mortality and heart rhythm, the high rate of mortality among the patients with complete heart block necessitates further attention to the subject.

Postoperative septic emboli is another important subject. Of the 6 postoperative septic emboli patients, 2 of them also had preoperative embolizations. Four of them had early mortality during their hospitalizations. This fact must also be emphasized in the double valve patients.

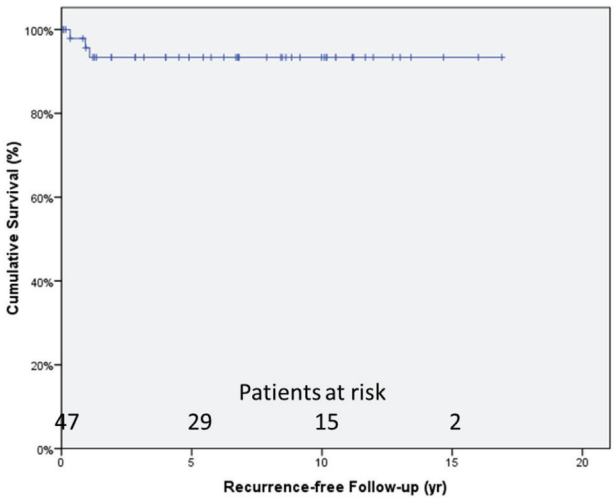

Figure 3. Survival free from recurrence.

The actuarial survival rates in this series were satisfactory in our point of view. Although some differences may be present with the larger series, like that of Gillinov and colleagues, the 10-year survival rate of around 80% was similar to their reported results. The survival was around 50% at 15 years (Figure 1), but the low number of patients at risk limits further comments on the subject. The survival rates free from recurrence and reoperation seem satisfactory. The use of prosthetic material could be a matter of debate related to the possibility of recurrences. Hagl and colleagues discussed this point for aortic root operations for endocarditis and they reported satisfactory results as well [Hagl 2002]. The survival free from recurrence and reoperation comes to a plateau in the second year after the operation, and the survival rates are above 90%. Considering the declining trend in the report by Gillinov and colleagues, the contradiction is interesting. This fact may partially be explained by the differences in the mortalities, in our point of view. Although they report no early mortality after the operation, there seems to be a significant rate of recurrence and reoperation, which significantly spikes in the first postoperative year [Gillinov 2001]. Our recurrences and reoperations have also occurred within the same duration but remained steady afterwards.

There are several limitations to the present study. First, it is a retrospective analysis and therefore may be subject to observer bias. However, we used multivariable analyses and tried to analyze our results thoroughly. Another fact may be the use of mechanical prosthesis at a high rate in this group of patients. One of the reasons is the limited availability of the homografts in Turkey. Although the use of bioprosthesis is increasing with the new deals of the social security institute, the long-term use of mechanical prostheses may have been a factor in the early mortality. However, as can be seen in Figure 3, the utilization of mechanical prosthesis does not seem to be affecting recurrence or reoperation requirements adversely. Lastly, the high rates of culture-negative cases must be addressed. This lack of culture results may also have contributed to early mortality but did not seem to affect recurrences in the patients who survived.

CONCLUSIONS

In conclusion, double valve endocarditis is a serious condition that has to be addressed carefully. The surgery should be done in a timely fashion and the surgeon must be aware of the high rates of mortality and morbidity in these patients. Although no association was found, heart blocks and septic embolizations must be handled with caution. The patients generally do well after surgery, and recurrences and reoperations decrease by the second year after the operation.

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